No parent should have to think twice about the juice they pour their children at breakfast, or a hamburger ordered during dinner out.
President Bill Clinton, radio address, 25 January 1997

Garlic Fights More than Vampires

Will a clove a day keep the doctor away? That's what John A. Milner, head of the department of nutrition at The Pennsylvania State University College of Health and Human Development, believes. Milner has led a number of studies that indicate that eating garlic (*Allium sativum*, a member of the lily family) may help reduce the incidence of breast cancer.

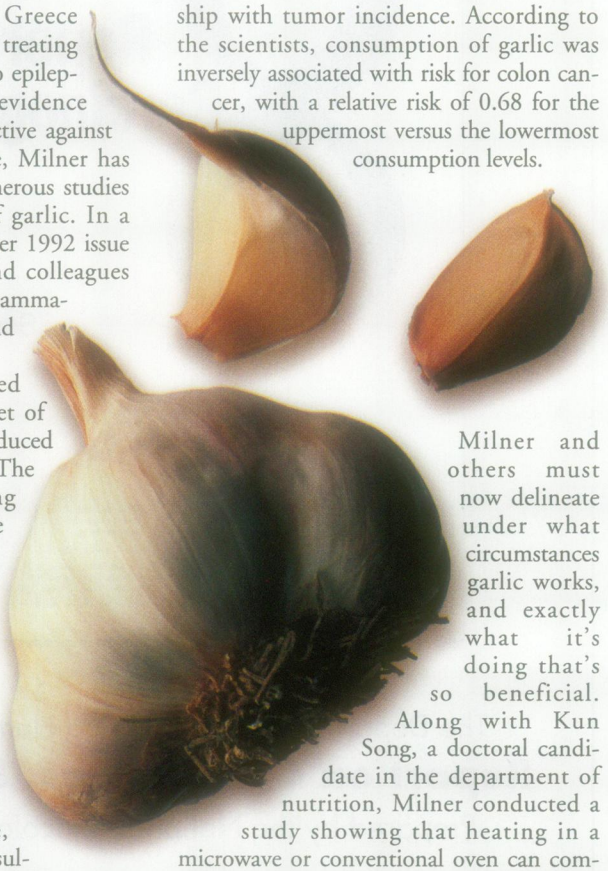
Garlic stimulates the body's immune system, boosting the killing ability of natural killer cells and increasing macrophage activity. Garlic also works against heart disease and strokes by lowering cholesterol levels and blood pressure. As an anticancer agent, Milner and others' work shows that garlic slows tumor growth and protects against potential damage from oxidation, free radicals, and nuclear radiation.

Garlic has long been a folk-remedy favorite—ancient manuscripts from Sumer, Egypt, China, and Greece describe the use of garlic for treating everything from snake bites to epilepsy. There is now scientific evidence that the bulbous herb is effective against cancer. Over the last decade, Milner has published and presented numerous studies on the anticancer effects of garlic. In a study published in the October 1992 issue of *Carcinogenesis*, Milner and colleagues tested the effect of garlic on mammary tumors in rats. They found that dietary garlic administered in powder form caused significant delays in the onset of first mammary tumors and reduced the final number of tumors. The team found that consuming garlic powder depressed the binding of the potent carcinogen 7,12-dimethylbenz(a)anthracene to mammary cell DNA in the rats, which may explain why fewer tumors developed.

In a study published in the 15 October 1993 issue of *Cancer Letters*, Milner and Sujatha Sundaram, a doctoral candidate at Penn State, tested the effect of six organosulfur compounds found in garlic on the growth of canine mammary tumor cells in culture. Three of the compounds—diallyl sulfide, diallyl disulfide, and diallyl trisulfide—sharply curbed the proliferation of tumor cells.

In the 19 April 1996 issue of *Cancer Letters*, Milner and research assistant Eric Schaffer compared the effect of garlic powder, the water-soluble compound S-allyl cysteine, and diallyl disulfide on the incidence of mammary tumors induced by *N*-methyl-*N*-nitrosourea. All three compounds were found to delay the onset of mammary tumors in female rats, and to reduce the overall incidence of tumors. Garlic powder led the race, with an 81% reduction in tumor incidence.

Finally, in a study published in the January 1994 issue of the *American Journal of Epidemiology*, a team of scientists from the University of Minnesota in Minneapolis and the University of Washington in Seattle looked at the effects of 15 different fruits and vegetables on tumors among a group of women from the Iowa Women's Health Study. Of all the fruits and vegetables studied, garlic was found to have the most dramatic relationship with tumor incidence. According to the scientists, consumption of garlic was inversely associated with risk for colon cancer, with a relative risk of 0.68 for the uppermost versus the lowermost consumption levels.



Milner and others must now delineate under what circumstances garlic works, and exactly what it's doing that's so beneficial. Along with Kun Song, a doctoral candidate in the department of nutrition, Milner conducted a study showing that heating in a microwave or conventional oven can completely strip garlic of its cancer-fighting benefits. However, if the garlic is minced or crushed and allowed to stand for at least 10 minutes before heating, there is little or no loss of benefits. The 10-minute standing period allows the enzyme alliinase in the garlic to begin producing allyl sulfur compounds—the compounds with the cancer-fighting properties. If the garlic is cooked immediately after chopping, the heating process deactivates the enzyme and the anticarcinogenic effects of the garlic are lost. Milner presented these findings at a symposium entitled Recent Advances on the Nutritional Benefits Accompanying the Use of Garlic as a Supplement, held in Newport Beach, California, 15–17 November 1998.

So far, the only known adverse health effects from eating too much garlic are gastrointestinal bleeding and stomach upset, plus of course the much-maligned garlic breath. But garlic's rising popularity—thanks to the increasing public and scientific interest in herbal medicine—means that consumers have a choice of ways to take their medicine, including some odorless varieties. Milner says that many of the commercially available garlic preparations that he and colleagues have tested, including deodorized varieties, have anticancer properties. There is little reason to avoid garlic and many reasons to enjoy it, says Milner—in whatever preparation desired.

Fertilizing or Contaminating?

Is fertilizer hazardous to your health? That question was raised by a sensational 1997 series in the *Seattle Times* that claimed to have unearthed a widespread and largely unregulated practice of recycling industrial waste into fertilizer. The material in question, which can contain radioactive matter, dioxins, or heavy metals, was being distributed to fertilizer companies or farms by manufacturers eager to avoid treatment and disposal costs by taking advantage of a loophole in the Resource Conservation and Recovery Act (RCRA), the major federal toxic chemical law.

The series was followed in March 1998 by a report titled *Factory Farming*, published by the Environmental Working Group (EWG), a nonprofit organization based in Washington, DC. Using data from the Toxics Release Inventory (TRI), the EWG said that 271 million pounds of toxic waste was received by 454 farms and fertilizer manufacturers in 38 states between 1990 and 1995. The waste contained 69 toxic chemicals, including nearly 6.3 million pounds of lead and lead compounds, 230,000 pounds of cadmium, and 16,000 pounds of mercury, along with 23.5 million pounds of industrial organic chemicals.

According to the EWG report, the TRI data reveal a "shocking practice by American fertilizer companies. They routinely 'recycle' toxic factory waste of all kinds into fertilizers. . . . The stuff is laden with lead, cadmium, arsenic, dioxin, and other high risk toxics that end up in fertilizers widely used by farmers in the United States." The group charged that state rules on the practice amount to a "loophole-riddled regulatory 'safety net.'" Although the EWG report does not say that actual harm from the practice has been demonstrated, Todd Hattenbach, an EWG researcher, says, "It's a dangerous practice because nobody is looking closely [at it]. The EPA is doing risk assessments, but they don't know what's going into the waste streams right now." The EWG contention is that, rather than having to demonstrate injury, companies should be required to demonstrate the safety of the practice before it is allowed.

John Mortvedt, a retired soil scientist who studied fertilizer contamination for 20 years at the National Fertilizer and Environmental Research Center in Muscle Shoals, Alabama, says the *Seattle Times* report was more sensational than it needed to be. But he agrees that the story exposed the RCRA loophole, the so-called "KO61" provision, which allows the unregulated transfer of dust—a waste product from the electric arc furnaces used in steel mills—to fertilizer companies. The dust contains zinc, an essential plant micronutrient, as well as lead, arsenic, cadmium, and nickel. According to the EWG report, nearly 30% of the industrial waste that became fertilizer originated at steel mills.

Due to the reporting system used in the TRI, the 271 million pounds of waste that became fertilizer between 1990 and 1995 may actually make up only part of the total transfers. Nevertheless, say critics of the EWG report, the total amount of waste recycled into fertilizer is probably a tiny fraction of overall fertilizer use (estimated at 54 million tons in 1995 alone). Furthermore, once the material is spread on farmland, it is diluted by incorporation into the soil. When contaminants present in a parts-per-million or parts-per-billion amount are spread on soil, Mortvedt notes, "They become inconsequential at some level." Natural soils, he adds, generally contain some heavy metals anyway.

Waste material can be safely recycled in some cases. In 1996, for example, Consolidated Papers recycled 161,000 tons of paper mill sludge on farms near its mill in Wisconsin Rapids, Wisconsin. Nitrogen in the sludge replaced conventional fertilizer, and the organic material helped the sandy soil hold water. The sludge was analyzed before disposal for 125 pollutants, including dioxins, heavy metals, and organic pollutants. Similar testing is also required for sewage sludge, which is commonly recycled on farmland under EPA regulation [see *EHP* 105(1):32–36 (1997)].

David Tenenbaum

Spraying sludge. The practice of recycling industrial wastes into fertilizer has come under fire from opponents who are concerned that toxic contaminants in the sludge may reach food and other crops.

The fertilizer industry says there is no cause for alarm. "Based on all the evidence to date, industry has concluded that there's no problem," says Jennifer Lombardi, communications director for the California Fertilizer Association. "But if conclusions based on science say there is a problem, industry would be supportive of a way to address that."

However, the issue of heavy metals in fertilizer is getting attention. Washington State has enacted regulations requiring contamination tests for fertilizers, but the tests look just for heavy metals. Texas has adopted rules that will allow the same concentrations of contaminants in fertilizer that are currently allowed for biosolids. California, which the EWG reported had received the greatest amount of industrial waste–derived fertilizer (37.6 million pounds), is completing a facilitative rulemaking process on heavy metals in fertilizer. By 1 March 1999, a state panel is supposed to suggest whether the California Department of Food and Agriculture should issue further regulations. Meanwhile, the American Association of Plant Food Control Officials, a group of fertilizer regulators, is developing a uniform standard on heavy metal content that will be presented to all U.S. states, Puerto Rico, and Canada for adoption.

The EPA has started a risk assessment of heavy metals in fertilizer. According to one EPA official involved in the discussions, the agency reviewed available data on fertilizer composition and found that "some fertilizer may have arsenic, lead, and cadmium—the three primary culprits—at levels they maybe should not have, but it's not an emergency out there." However, the EWG maintains that the EPA is not able to calculate the risks because it lacks enough data on what components are actually contained in fertilizer. An upcoming revision of RCRA's provisions, scheduled for publication in early 2000, may close the KO61 loophole, but with state regulation in the offing, the EPA is unlikely to write comprehensive fertilizer regulations. The EWG's vice president for research, Richard Wiles, advocates halting the use of industrial waste as fertilizer, saying, "We need a moratorium until we have a reasonable program of testing waste before it's manufactured into fertilizer."

Herbal Medicine is Potent Estrogen

When a patient complained to oncologist Robert DiPaola of the Cancer Institute of New Jersey of breast tenderness, muscle pain, and loss of libido—all classic side effects of estrogen therapy—the doctor was perplexed. His patient had rejected hormone treatment for prostate cancer because of its abhorrent side effects and limited potential for a cure.

The patient also showed signs of estrogen's good effects. His level of prostate-